

REMARKS

Claims 1 – 19 and 21 – 36 are pending in this application. Claim 20 was cancelled by previous amendment.

CLAIMS

Independent claim 1 has been earlier amended so that the claimed stroke multiplying shape memory alloy actuator includes a recess formed in the heat sink that separates the ends of at least one SMA wire from the heat sink. This limitation is directed towards one of the key advantages of the stroke multiplying shape memory alloy actuators of the present invention, namely, increasing the effective operating length of the shape memory alloy wires. The effective operating length of the shape memory alloy wires is related to the amount of the shape memory alloy wire heated above the austenite finish temperature (A_f). The central portion of the shape memory alloy wire is cooled primarily by the proximity of the shape memory alloy wire to the heat sink. The ends of the shape memory alloy wire are not only cooled by the proximity of the shape memory alloy wire to the heat sink but also by conduction where the ends of the shape memory alloy wire attach to the rigid member. Because there are two modes of heat transfer at the ends of the shape memory alloy wire, the ends of the shape memory alloy wire often remain below A_f . The use of a recess in the heat sink reduces the heat transfer related to the proximity of the shape memory alloy wire to the heat sink. By reducing one of the heat transfer mechanisms operating on the ends of the shape memory alloy wires, more of the shape memory alloy wire near the ends is heated above A_f . Thus, the benefit of increasing the effective operating length is obtained, by forming a recess in the heat sink that separates the ends of at least one SMA wire from the heat sink. This operation is discussed in the specification on page 11.

Independent claim 22 is directed towards a shape memory alloy actuator that includes the advantageous features of forming a recess in a rigid planar elongate member and attaching the shape memory alloy wire to the rigid planar elongate member adjacent the recess. The benefits of using shape memory alloy actuators having rigid planar elongate members with recesses is set forth above with regard to claim 1. Support for this claim and the additional limitations of dependent claims 23, 24, 25 and 26 are found on pages 11, 16 – 18 and in Figures 7, 8A and 8B.

Independent claim 27 is directed towards a sliding plane shape memory alloy actuator with a rigid member having the beneficial recess feature described above. In addition, this claim

is directed towards the beneficial use of the at least two different heat transfer mechanism at work in these embodiments of the present invention. A first heat transfer mechanism dominates the heat transfer between the central portion of the shape memory alloy wire and the rigid member. A second different heat transfer mechanism dominates the heat transfer between the rigid member and the portion of the shape memory alloy wire proximate to the portion of the rigid member having the recess. The recognition and beneficial utilization of these two heat transfer mechanisms to improve the operational capabilities of the sliding plane shape memory alloy actuators of claim 27 and dependent claims 28 – 32 are discussed in the specification on at least pages 16 – 18 and Figures 7, 8A and 8B.

Independent claim 33 is directed towards a sliding plane shape memory alloy actuator that beneficially utilizes the heat transfer mechanism common to the ends and the central portion of the shape memory alloy wire. The heat transfer mechanism common to the ends and the central portion of the shape memory alloy wire is the spacing between the shape memory alloy wire and the rigid member. The shape memory alloy wire is spaced from the rigid member at a first spacing in the central portion and at a second spacing at the ends. The beneficial use of the spacing between the shape memory alloy wire and the rigid member provides, at least, the advantages described above and the increase in shape memory alloy wire operational length. The recognition and beneficial utilization of the heat transfer mechanism common to the central portion and ends of the shape memory alloy wire to improve the operational capabilities of the sliding plane shape memory alloy actuators of claim 33 and dependent claims 34-36 are discussed in the specification on at least pages 16 – 18 and Figures 7, 8A and 8B.

Rejections under 35 USC 102

The Examiner has rejected claims 1-3, 14-15, 17-18 and 21 under 35 U.S.C. 102(e) as being anticipated by U.S. 6326707 (Gummin '707).

The Examiner contends that “the recess is simply the ends of the heat sink. Gummin discloses at both ends of the heat sink 41, there are holes for the SMA 36 to go through.”

Applicant disagrees with the Examiner's contention and believes that the Examiner is using impermissible hindsight to read Gummin's disclosure onto Applicant's invention. Gummin illustrates an SMA wire 36 penetrating an end bracket 33/34 and attached via anchor point 37. (Gummin Figures 1 and 2 and Col 5 lines 1-14)

Gummin neither discloses nor illustrates a “recess” as suggested by the Examiner. An examination of the Figures 1 and 2 and the Gummin specification reveal that Gummin provides no reference number indicating the point where the SMA wire 36 penetrates end bracket 33/34 and makes no mention of the penetration. The absence of any mention of the feature the Examiner relies upon further indicates that Gummin placed no particular importance on the mechanical fastening means used in his linear actuator motor 30. The Examiner contends that the “holes” in the bracket are the claimed recess. However, claim 1 requires that the recess “separates the end of at least one SMA wire from the heat sink.” Gummin only illustrates a unitary junction between the SMA wire 36 and the end bracket 33/34. (Gummin Figures 1 and 2) Assuming arguendo that the “holes” are a “recess” as the Examiner contends, such a construction of Gummin is still lacking because there is no separation of the “end of one SMA wire from the heat sink” as claimed because Gummin only illustrates a unitary construction.

For at least the reasons set forth above, independent claim 1 is distinguishable over Gummin ‘707. Since Gummin ‘707 provides no teaching or suggestion for the claimed “recess formed in the heat sink separates the ends of at least one SMA wire from the heat sink”, Gummin ‘707 neither anticipates nor renders obvious Applicant’s independent claim 1. Withdrawal of the 35 USC 102 (e) rejection of claim 1 under Gummin ‘707 is respectfully requested. Claims 2, 3, 14, 15, 17, 18 and 21 all depend from allowable claim 1. Therefore, Applicant respectfully requests the withdrawal of the 35 USC 102 (e) rejection of claims 2, 3, 14, 15, 17, 18 and 21 under Gummin ‘707 as well.

The Examiner has rejected claims 1-19 and 21 under 35 USC 102 (e) as being anticipated by U.S. Patent 6,574,958 to MacGregor (MacGregor ‘958).

Independent claim 1 is distinguishable over MacGregor ‘958 in at least that MacGregor ‘958 provides no teaching or suggestion regarding the claimed “recess formed in the heat sink separates the end of at least one SMA wire from the heat sink”. In fact, MacGregor ‘958 only illustrates elongate members (i.e., 61, 512, 513, 1815, 1816, 1812 etc.) similar to elongate member 62 in Figure 6 of the present invention. More specifically, MacGregor ‘958 lacks any disclosure or suggestion of the novel rigid members 72, 82 and 812 having, respectively, recesses 74, 84, and 814 (see Figures 7, 8A and 8B). As such, MacGregor ‘958 does not

anticipate independent claim 1. Applicant therefore requests withdrawal of the rejection of claim 1 under 35 U.S.C. 102 (e) as anticipated by MacGregor '958. Claims 2 - 19 and 21 all depend from allowable claim 1. Therefore, Applicant respectfully requests the withdrawal of the 35 USC 102 (e) rejection of claims 2 - 19 and 21 under MacGregor '958.

The Examiner has rejected claims 22-24, 27-33 and 36 under 35 USC 102(b) as being anticipated by US Patent 4,027,953 to Jacob (Jacob '953). Jacob '953 discloses only a pair of "C" shaped bimetal strips 20 and 22 for positioning a mirror 14. Jacob '953 provides no teaching or suggestion whatsoever regarding shape memory alloy wires. Because Jacob '953 provides no teaching or suggestion regarding shape memory alloy wires it fails to anticipate independent claims 22, 27 and 33 that recite "a shape memory alloy wire." Therefore, Applicant respectfully requests that the Examiner withdraw the 35 USC 102 rejection of claims 22, 27 and 33 under Jacob '953. Dependent claims 23, 24, 28, 29, 30, 32, 32 and 36 depend from allowable independent claims. Therefore, Applicant respectfully requests the withdrawal of the rejection of dependent claims 23, 24, 28, 29, 30, 32, 32 and 36 under Jacob '953.

The Examiner has rejected claims 22-24, 27-33 and 36 under 35 USC 102(b) as being anticipated by US Patent 4,806,815 to Honma (Honma '815). The Examiner contends that Honma discloses a thermal actuator comprising a rigid elongate member (housing 1) having a recess formed therein. Honma '815 describes a hollow cylindrical box member 1 with a lid 2. (Col. 5 lines 4-6 and Figures 1 and 2). Applicant believes that the Examiner is improperly construing the reference and using impermissible hindsight to read Applicant's claimed "rigid planar elongate member" onto Honma's cylindrical box. Honma '815 provides no teaching or suggestion whatsoever regarding Applicant's rigid planar elongate member. Because Honma '815 provides no teaching or suggestion regarding the claimed rigid planar elongate member it fails to anticipate independent claims 22, 27 and 33. Therefore, Applicant respectfully requests that the Examiner withdraw the 35 USC 102 rejection of claims 22, 27 and 33 under Honma '815. Dependent claims 23, 24, 28, 29, 30, 32, 32 and 36 depend from allowable independent claims. Therefore, Applicant respectfully requests the withdrawal of the rejection of dependent claims 23, 24, 28, 29, 30, 32, 32 and 36 under Honma '815.

Rejections Under 35 U.S.C. 103(a)

The Examiner has rejected claims 4 and 5 under 35 U.S.C. 103(a) as being unpatentable over the combination of Gummin '607 and U.S. Patent 2, 518, 941 to Satchwell et al (Satchwell '941).

Claims 4 and 5 depend from independent claim 1. Independent claim 1 is distinguished over Gummin '707 above.

Satchwell '941 describes a regulator for a heating apparatus. Satchwell '941 provides no teaching or suggestion related in any way to the claimed stroke multiplying shape memory alloy actuator "where at least the central portion of the SMA wires are in close proximity to a heat sink and a recess formed in the heat sink separates the ends of at least one SMA wire from the heat sink." As such there is no combination of Gummin '707 with Satchwell '941 that renders obvious Applicant's independent claim 1. Because claims 4 and 5 depend from allowable claim 1, Applicant respectfully requests that the withdrawal of the rejection of claims 4 and 5 under 35 U.S.C. 103 of Gummin '707 in view of Satchwell '941.

The Examiner has rejected claims 6-13 and 16-18 under 35 U.S.C. 103 (a) as being unpatentable over Gummin '607. The Examiner contends that Gummin '607 discloses all of the claimed subject matter of independent claim 1 and that it would have been obvious to one of ordinary skill in the art to modify the actuator of Gummin '607 to the claimed dimensions.

As set forth above, independent claim 1 is distinguishable over Gummin '707 in at least that Gummin '707 provides no teaching or suggestion regarding, at least, (1) a recess formed in a heat sink and (2) the recess in the heat sink separating the end of an SMA wire from the heat sink. As such, independent claim 1 is patentable over Gummin '707. Because claims 6-13 and 16-18 depend from allowable claim 1, Applicant respectfully requests the withdrawal of the 35 U.S.C. 103 (a) rejection of claims 6-13 and 16-18 as unpatentable over Gummin '707.

The Examiner has rejected claim 19 under 35 U.S.C. 103 (a) as being unpatentable over the combination of Gummin '607 and U.S. Patent 5,165,897 to Johnson (Johnson '897). The Examiner contends that Gummin '607 discloses all of the claimed subject matter of claim 1 but does not disclose the actuator having a switch of a power circuit.

Claim 19 depends from independent claim 1. As set forth above, independent claim 1 is distinguishable over Gummin '707 in at least that Gummin '707 provides no teaching or

suggestion regarding the placement of an SMA wire relative to a heat sink where the heat sink has a recess formed therein.

Johnson '897 describes a programmable tactile stimulator array system and method of operation. Johnson '897 provides no teaching or suggestion related in any way to the claimed stroke multiplying shape memory alloy actuator "where at least the central portion of the SMA wires are in close proximity to a heat sink and a recess formed in the heat sink separates the ends of at least one SMA wire from the heat sink." As a result, no combination of Gummin '707 with Johnson '897 will render obvious Applicants dependent claim 19. Applicant therefore respectfully requests the withdrawal of the 35 U.S.C. 103 (a) rejection of dependent claim 19 as unpatentable over Gummin '707 in view of Johnson '897.

The Examiner has rejected claims 34 and 35 under 35 USC 103 (a) as unpatentable over US Patent 4,027,953 to Jacob (Jacob '953).

Claims 34 and 35 depend from independent claim 33 that has been distinguished above over Jacob '953 because Jacob '953 lacks any teaching or suggestion regarding SMA wires. Claim 33 is now allowable. Because claims 34 and 35 depend from allowable claim 33, Applicant respectfully requests the withdrawal of the 35 USC 103 rejection of claims 34 and 35 over Jacob '953.

The Examiner rejected claims 1-20 under the judicially created doctrine of obviousness type double patenting as being unpatentable over the issued claims of MacGregor '958 in view of Gummin '707. Claim 20 was cancelled by earlier amendment. As distinguished above, both Gummin '707 and MacGregor '958 lack, at least, a recess formed in a heat sink and a recess that separates the ends of at least one SMA wire from the heat sink. As a result, no combination of Gummin '707 and MacGregor '958 can render obvious Applicant's claimed invention in claims 1-19. Applicant respectfully requests the withdrawal of the double patenting rejection of claims 1-19 over Gummin '707 in view of MacGregor '958.

In view of the foregoing, it is respectfully submitted that claims 1-19 and 21-36 are fully distinguished over the prior art of record and therefore are in condition for allowance, the prompt issuance of which is respectfully requested.

If there are any outstanding prosecution matters that can be resolved through a telephone conference, the Examiner is requested to contact the undersigned attorney at 650-843-5798.

The Commissioner is hereby authorized to charge any appropriate fees that may be required by this filing and to credit any overpayment to Deposit Account No. 03-3117.

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